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IS 9002-2 (1977): Equipment and Environmental Tests for Electronic and Electrical Items, Part 2: Chamber for Dry Heat Test [LITD 1: Environmental Testing Procedure]



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Indian Standard

SPECIFICATION FOR
EQUIPMENT AND ENVIRONMENTAL TESTS
FOR ELECTRONIC AND ELECTRICAL ITEMS

PART II CHAMBER FOR DRY HEAT TEST

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SPECIFICATION FOR EQUIPMENT AND ENVIRONMENTAL TESTS FOR ELECTRONIC AND ELECTRICAL ITEMS

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(Continued on page 2)

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IS : 9002 (Part II) - 1977

(Continued from page 1)

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Indian Standard

SPECIFICATION FOR EQUIPMENT AND ENVIRONMENTAL TESTS FOR ELECTRONIC AND ELECTRICAL ITEMS

PART II CHAMBER FOR DRY HEAT TEST

0. FOREWORD

0.1 This Indian Standard (Part II) was adopted by the Indian Standards Institution on 1 September 1977, after the draft finalized by the Environmental Testing Procedures Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 The object of this standard (Part II) is primarily to guide the environmental equipment manufacturers with respect to broad specifications for their equipment and to assist the users of such equipment to properly define their requirements in the indent for the equipment. The requirements of the equipment largely depend on the conditions of environmental tests to be simulated or created. It is expected that this standard will harmonize the various requirements of the equipment.

0.3 Certain requirements have been specified in a general form in view of practical difficulties in defining such requirements quantitatively. It is presumed that with the experience gained, more precise requirements will be laid down for such equipment.

0.4 An overall performance assessment of the complete equipment for a short duration has been included although it may be realized that it may not be entirely sufficient. This will at least ensure the functional performance and operatability of the equipment. Many of the constructional requirements specified can be checked through visual examination.

0.5 In view of the subjective nature of some of the requirements, sufficient care shall be taken in using this standard.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (revised).

1. SCOPE

1.1 This standard (Part II) lays down guiding requirements for the design of dry heat chamber required for carrying out dry heat tests in accordance with IS : 9000 (Part III)-1977*.

2. TERMINOLOGY

2.0 For the purpose of this standard, the definitions and explanation of terms given in IS : 9000 (Part I)-1977† shall apply.

3. TEMPERATURE, HUMIDITY AND AIR CIRCULATION

3.1 The chamber shall be capable of maintaining the specified temperature in the working space, within the tolerance required, at any point in the working space of the chamber, for the specified duration.

3.1.1 The preferred temperature range shall be from ambient to 200°C unless otherwise specified.

NOTE — The required ambient temperature shall be indicated by the purchaser.

3.1.2 The chamber shall be capable of maintaining following temperatures with the tolerance specified at any point in the working space of the chamber:

+200	±2°C
+175	±2°C
+155	±2°C
+125	±2°C
+100	±2°C
+85	±2°C
+70	±2°C
+55	±2°C
+40	±2°C (see Note 1)
+30	±2°C (see Note 1)

NOTE 1 — Cooling system may be required in places where the ambient temperature is higher than these temperatures.

NOTE 2 — Where due to the size of the chamber it is not feasible to maintain these tolerances, the tolerance may be widened to ±3°C up to 100°C and ±5°C up to 200°C. When this is done, the tolerance used shall be specified in the test report.

NOTE 3 — In the absence of other considerations, temperatures above 200°C and up to 1 000°C should be chosen from the following values. The tolerance in each case being ± 2 percent of the temperature in °C:

250°C, 315°C, 400°C, 500°C, 630°C, 800°C and 1 000°C.

*Basic environmental testing procedures for electronic and electrical items: Part III Dry heat tests.

†Basic environmental testing procedures for electronic and electrical items: Part I General.

3.1.3 The chamber shall be capable of maintaining the temperatures specified in **3.1.2** at least for 96 hours continuously in any single run.

3.1.4 Unless otherwise specified, the temperature at any point inside the chamber shall be within $\pm 2^{\circ}\text{C}$ of the test temperature.

NOTE — The tolerance may be modified depending on the size of the chamber.

3.1.5 It shall be possible to control the rate of change of temperature within the chamber which shall not to exceed 1°C per minute averaged over a period not exceeding 5 minutes.

3.1.6 In order to limit radiation problems, the temperature of the walls of the chamber, after temperature stability has been reached, where relevant, shall not differ by more than 3 percent of specified temperature of the test chamber in deg K. This requirement applies to all parts of the chamber walls and the items shall be unable to 'see' any heating or cooling elements which do not comply with this requirement.

3.2 It should be possible to maintain the relative humidity not exceeding 50 percent for tests at a temperature lower than 35°C . The absolute humidity shall not exceed 20 g of water vapour per cubic metre of air (corresponding approximately to 50 percent relative humidity at 35°C). When testing is performed at a temperature lower than 35°C , the relative humidity shall not exceed 50 percent.

3.3 Provision may be made for forced air circulation to maintain homogenous conditions within the chamber. It should be possible to vary the velocity of the air. The velocity of air in such a case should be as low as possible. The means for circulation of the air shall not protrude into the working space.

3.3.1 In the case of chamber for testing heat dissipating items with no forced air circulation, the chamber shall be large enough compared with the size and amount of heat dissipation of the test item to allow a simulation of the effects of free air conditions [see **2.14** of IS : 9000 (Part I)-1977*].

The requirement and the size of chamber in which the effect of free air conditions are simulated are given in Appendix A as a function of size and heat dissipation per surface unit of the test item.

3.4 The temperature in the chamber shall be checked with temperature sensing devices located so as to comply with the conditions specified in **3.1.2** of IS : 9000 (Part I)-1977*.

*Basic environmental testing procedures for electronic and electrical items; Part I General.

3.5 Where required, the chamber shall be capable of maintaining the temperature in accordance with the specified duty cycle. Due provision shall be available in such a case to maintain the test temperature at a steady figure, if required.

NOTE 1 — In the case of components, a staggering of the on-periods will usually suffice, provided that at any time the distribution of components on-load is reasonably uniform throughout the test chamber.

NOTE 2 — Where a duty cycle is specified, the design of the chamber shall be such that during the off-load periods the temperature of the chamber shall not fall below the specified test temperature (*see* Fig. 1).

4. CONSTRUCTION, WORKMANSHIP AND FINISH

4.1 General

4.1.1 The chamber is to be fabricated preferably with welded steel of sufficient thickness to provide necessary mechanical strength. Corners and seams of the interior liners are to be so welded to allow for expansion and contraction under all temperature changes to prevent distortion and damage.

4.1.2 The materials used for the construction of interior walls of the chamber shall be of stainless steel of the non-corrosive type preferably.

4.1.3 The walls of the chamber shall be near to thermal black and shall have an emissivity coefficient of not less than 0.7.

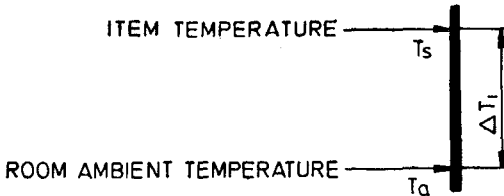
4.2 Working Volume — The working volume of the chamber should be chosen from the following preferred values, unless otherwise specified:

0.25, 0.5, 1, 2.5 m³

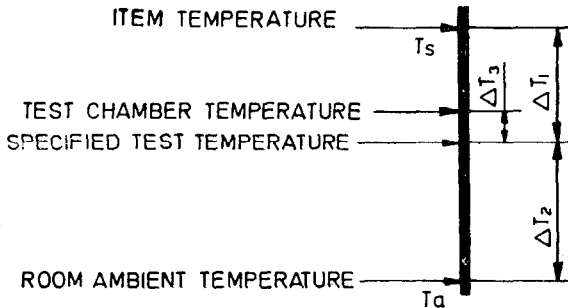
4.3 Insulation — The chamber shall be suitably and sufficiently insulated for the temperature ranges involved. The insulation and the insulated space shall be properly sealed so as to prevent deterioration and loss of heat. The insulation shall be such as to ensure that the temperature rise of the external surface of the chamber does not exceed 20°C and in no case the maximum surface temperature should exceed 60°C under any ambient conditions.

4.4 Doors — A suitable front door shall be provided which shall be capable of full opening to ensure full access to the working space. The door shall be fitted with suitable gaskets to prevent heat losses and infiltration of external air and moisture. The door and gaskets shall withstand the temperature range involved without undue distortion and deterioration.

4.5 Shelves — Removable, perforated shelves capable of supporting without distortion the items of specified mass shall be provided. The number of shelves and adjustable heights are to be as specified.



Stage 1—Item loaded. Test in laboratory conditions with no forced air circulation. Measurement of item temperature.



Stage 2—Item loaded. Test in chamber with forced air circulation. Monitoring on item temperature. [ΔT_3 shall be small. Measurement of the test chamber temperature is carried out in accordance with 2.1 of IS : 9000 (Part I)-1977 Basic environmental testing procedures for electronic and electrical items : Part I General .]

FIG. 1 DIAGRAMMATIC REPRESENTATION OF TEST WITH FORCED AIR CIRCULATION

4.6 Viewing Window — A viewing window of the required dimension shall be provided on the door preferably of the multipanel type, hermetically sealed.

4.7 Terminal Panel — As an optional facility, a suitable terminal panel for making external connection with the test items inside the chamber shall be provided. The relevant details and requirements, for example, voltage and current levels, are to be as specified.

IS : 9002 (Part II) - 1977

4.8 Port Hole — One or more port hole of specified dimension may be provided as an optional item at the specified point of the chamber for accommodating wires, hoses, etc. Means shall be provided for sealing of the port hole when not in use to ensure thermal integrity.

4.9 Interior Light — Provision shall be made for illuminating the working space by incandescent lamps. The lamps shall be so positioned as not to project into the working space.

4.10 Workmanship — Workmanship shall be of good current engineering practice.

4.11 Finish — The external and internal finish of the chamber shall be as specified for parts not otherwise covered so as to ensure protection against corrosion and other similar effects.

4.12 Miscellaneous

4.12.1 The chamber shall be designed for optimum performance and economic continuous operation with minimum maintenance requirement. It shall occupy minimum floor area.

4.12.2 The electrical and electronic components and cables shall conform to relevant Indian Standards, wherever applicable.

4.12.3 Provision of castor wheels shall be made for easy movability of the equipments, if required.

5. INSTRUMENT CONSOLE

5.1 An instrument console consisting of required instruments should preferably be fitted to the chamber for ease of operation. This instrument console should include, inter alia, the following:

- a) Indicating panel consisting of mains on-off switch, mains-on indicator lamp, temperature indicator, on-off switch for air circulation.
- b) Necessary instruments for controlling and recording of temperature and relative humidity. The temperature control stability shall be within $\pm 0.5^{\circ}\text{C}$.
- c) Input regulation to ensure close temperature accuracy and for modulating, that is, adjusting, regulating or varying heating capacities from 0 percent to 100 percent.

5.1.1 Provision for automatic test programming be made as an optional facility, if required.

6. POWER SUPPLY REQUIREMENTS

6.1 The test equipment shall be capable of operating from an ac supply of 50 Hz either from single phase 240 V ± 10 percent or three phase 415 V ± 10 percent. Total power supply input shall be declared by the manufacturer as required by the purchaser.

7. SAFETY

7.1 Adequate electrical safety arrangement shall be incorporated in the chamber design to avoid electric shock and damage to the chamber.

7.2 The safety protection should be as follows:

- a) Protection against supply voltage variation;
- b) Safety cut-outs for high temperature;
- c) Adequate heat/electrical insulation at control panel;
- d) Safety alarm (visual and audio) in case of chamber malfunctioning, when required; and
- e) Provision for interlocking of fan with heater circuit.

8. MARKING

8.1 The equipment shall be marked with the following information:

- a) Manufacturer's name or trade-mark;
- b) Type designation;
- c) Working volume and range of operating conditions;
- d) Power supply requirements; and
- e) Any other additional marking as required.

9. TESTS

9.1 Each chamber shall be subjected to the following tests:

- a) Visual examination and inspection; and
- b) Performance.

9.2 Visual Examination — Each chamber shall be visually examined and inspected for compliance with the relevant requirements of the standard.

9.3 Performance — Each chamber shall be subjected to performance run at specified temperature (*see 3*) for a minimum period of 96 hours continuously. Temperatures shall be recorded throughout the test and the observed performance should meet the specified requirements.

10. INSTRUCTION MANUAL

10.1 Each chamber shall be provided with instruction manual which shall contain the following:

- a) Operating instruction;
- b) Maintenance and service instruction;
- c) Schematic diagrams and design of layout;
- d) List of component parts with performance data; and
- e) List of spare parts.

11. INFORMATION TO BE FURNISHED BY THE INDENTOR

11.1 The following information shall be furnished by the indentor:

- a) Temperature range of the chamber if other than 200°C;
- b) Ambient temperature in the chamber;
- c) Duty cycle (*see 3.5*);
- d) Number of shelves and adjustable heights (*see 4.5*);
- e) Dimensions of viewing window (*see 4.6*);
- f) Relevant details and requirements of terminal panels (*see 4.7*);
- g) Dimensions of port hole (*see 4.8*);
- h) External and internal finish (*see 4.11*);
- j) Provision of castor wheels (*see 4.12.3*);
- k) Interlock provision if required [*see 5.1 (a)*];
- m) Automatic test programming, if required (*see 5.1.1*);
- n) Total power supply input (*see 6*);
- p) Safety alarm if required [*7.2 (d)*]; and
- q) Any other characteristics or parameters with tolerances.

APPENDIX A

(Clause 3.3.1)

VOLUME OF TEST CHAMBER

A-1. SIZE OF CHAMBER

A-1.0 The size of the chamber shall be such that the conditions stated below are satisfied.

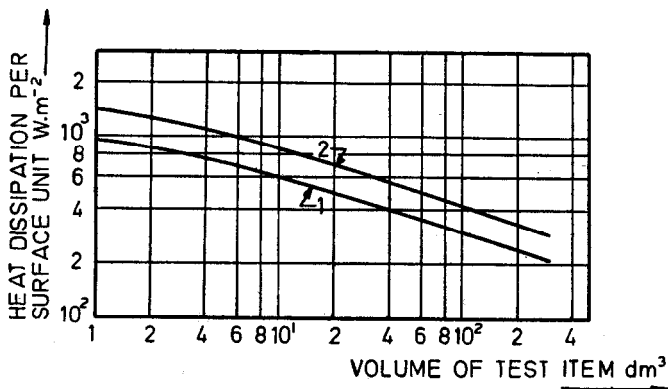
A-1.1 Volume of Item Equal to or Less Than 1 dm³

A-1.1.1 *Power Dissipation Equal to or Less Than 50 W* — The minimum distance between any surface of the test item and the corresponding wall of the chamber shall be not less than 10 cm.

A-1.1.2 *Power Dissipation Greater Than 50 W and Equal to or Less Than 100 W* — The minimum distance between any surface of the test item and the corresponding wall of the chamber shall be not less than 20 cm.

A-1.2 Volume of Item Greater Than 1 dm³ — The minimum distance between any surface of the test item and the corresponding wall of the chamber shall be 10 cm unless the relationship between the volume of the test item and the power dissipation per unit of surface area is such that the curves given in Fig. 2 indicate that a greater distance is required. The ratio between the volume of the chamber and the volume of the item shall be not less than 5 : 1. The item shall, as far as practical, be placed close to the centre of the test chamber so as to have as much space as possible between any part of the test item and the chamber walls. The monitoring of ambient temperature is carried out appropriately to ensure that it is within the limits desired [see also 2 of IS : 9000 (Part I)-1977* for definitions and conditions concerning temperatures].

*Basic environmental testing procedures for electronic and electrical items: Part I General.



Curve 1 shows the maximum allowable heat dissipation per unit of surface area as a function of the volume of the test item when the distance between the surface of the item and the chamber is 10 cm.

Curve 2 shows the same relationship when the distance is 20 cm.

NOTE 1 — There shall be not less than 10 cm between any surface of the test item and the corresponding wall of the chamber.

NOTE 2 — The volume of the item is defined as the volume of the smallest parallelepiped in which the item may be inscribed.

NOTE 3 — The surface area of the item is defined as the total surface area of the smallest right-angled parallelepiped in which the item may be inscribed. If the heating of the item is asymmetric, the surface under consideration is only that of the side or sides most affected by the heat generation.

FIG. 2 HEAT DISSIPATION PER UNIT OF SURFACE AREA AS A FUNCTION OF THE VOLUME OF THE TEST ITEM